REMARKS/ARGUMENTS

Claims 3, 10 and 15 have been cancelled without prejudice or disclaimer therein. Claims 1, 5, and 20 are amended to clarify the Applicants' subject matter. New Claims 39 to 43 are added. Support for the amended and added subject matter is found in the Specification. For example, support for the amendment to claim 1 can be found in the wording of original Claims 1, 3, 10 and 15, and from Figure 2 and the accompanying description from page 10, lines 28 to page 11, line , of Applicants' Specification. Claims 5 and 20 have been amended for consistency with claim 1. Support for new claims 39 and 40 can be found on page 3, lines 1 to 3 of the Specification. Support for new claim 41 can be found from page 15, lines 27 to 31. New claim 42 is based on claims 1, 20, 39 and 41. New Claim 43 is based on Claim 21. Accordingly, no new matter has been added.

In view of the above amendments and following remarks, reconsideration of this application for allowance is respectfully requested.

Overview

A key advantage of the fluorometer of the Applicants' subject matter is the capability to detect fluorescence remotely from the fluorometer, preferably at a distance of up to several meters from the fluorometer (see new claim 39), for example between 1 and 15 meters from the fluorometer (see new claim 40). In addition, the fluorometer maintains a relatively large detection area by virtue of the generally conical divergent excitation beam and generally conical convergent detection volume, as recited in amended claim 1.

In contrast, most prior art devices are only capable of detecting fluorescence in samples that are very close to the fluorometer. For example, the devices of primary references Bentsen (U.S. Patent No. 6,372,895) and Carlson (U.S. Patent No. 4,771,629) do not detect fluorescence remotely from the device. Instead, fluorescence is detected in a sample cell that forms part of the device. In the case of Bentsen, focussing optics and/or a light guide are used to direct light from one part of the device to another via the sensor element (see col. 24, lines 5 to 33). In the case of

Carslon, the sample cell 21 is located between two optical fibres 17, 19 (see for example col. 5, lines 50-51).

With regard to secondary reference Tokhtuev (WO 03/02337), the detection region is immediately in front of the optical module, as can be seen from Figure 2. Also, secondary reference Frungel (U.S. Patent No. 3,666,945) does not mention its range but the technology is similar to that disclosed in other Fungal Patents – for example U.S. Patent No. 4,178,512 which is discussed in the background section of the present Patent application – and is only capable of detecting fluorescence within a few inches of the detector.

Other prior art devices are capable of detecting fluorescence over longer distances by using a laser as the light source. However, the use of a laser significantly reduces the detection area because the laser produces a highly focussed narrow beam.

The Applicants have found that in order to solve the problem of increasing the detection range of a fluorometer while maintaining a relatively large detection area, a combination of features is listed, namely:

A. an LED excitation source.

B. at least one collimating lens.

C. a generally conical divergent beam.

D. a generally conical convergent detection volume.

E. modulation of the excitation beam and corresponding spectral analysis of the received signals.

The LED light source has a relatively narrow frequency band when compared to, say, a white light source and this reduces divergence of the projected beam. The collimating lens further controls the divergence of the projected beam. The conical divergent nature of the beam facilitates a relatively large detection area. Even so, levels of fluorescence are relatively low and so in order to detect fluorescence the detection system must also perform the stipulated spectral analysis. Another advantage of the relatively narrow band of the LED light source is that it reduces the frequencies of light that may be picked up by the detector. This simplifies the

filtering required at the detector and reduces the chance that unwanted frequencies will give false readings.

All of the features A to D above are recited in independent claims 1 and 42 and they all make an important contribution to the ability to reliably detect fluorescence at relatively large distances from the fluorometer (for example page 3 paragraph 1 of the present application gives a typical working distance of between 1 and 15 meters) while maintaining a relatively large detection area.

The Applicants submit that it is a combination of all of these features that allows the technical problem to be solved. As is discussed in more detail below, this combination is not suggested by the prior art and it is noted in particular that none of the devices in the cited prior art documents is capable of detecting fluorescence at a distance of up to several meters from the fluorometer while maintaining a relatively large detection volume. One key advantage of the Applicants' subject matter is that the resultant fluorometer is suitable for detecting fluorescence around underwater structures such as pipes and risers without having to get too close to the structures or without the need for a scanning movement. This is particularly advantageous when the fluorometer is mounted on a remotely operated vehicle (ROV), such as is illustrated in Figure 3 of the present application (and claimed in claims 36 and 37), since it may not always be possible for such a vehicle to get very close to the structure in question.

Objections

The Office Action objects to Claim 35 for informalities, specifically, being dependent on a cancelled claim. Claim 35 has been amended to depend on non-cancelled claim 18. Accordingly, the withdrawal of this objection is respectfully requested.

Rejection under 35 U.S.C. §112

The Office Action rejects Claims 3 and 10 under 35 U.S.C. §112, second paragraph. Applicants have cancelled claims 3 and 10, therefore this rejection is moot.

Rejections under 35 U.S.C. §103

The Office Action rejects Claims 1, 3-6, 8-10, 12, 15, 16 and 18 under 35 U.S.C. §103(a) in view of Bentsen (U.S. Patent No. 6,372,895) and Carlson et al. (U.S. Patent No. 4,771,629). This rejection is respectfully traversed.

Applicant submits that Bentsen additionally does not disclose at least the following features of Claim 1: m*eans for causing said excitation light to form, in use, a generally conical divergent beam projecting from the fluorometer, said beam causing means comprising at least one collimating lens.* In contrast, Bentsen's excitation light is directed by focusing optics 334 and/or light guiding elements 336 (see column 24, lines 6-9 and lines 21-33).

In addition, Bentsen does not disclose the following feature of Claim 1: s*aid at least one lens of the detection system is arranged to provide generally conical divergent detection volume for the detection system, said generally conical detection volume converging in a direction towards the fluorometer and at least partially overlapping with said generally conical divergent beam.*

In contrast, Bentsen discloses the use of collection optics 344 and optionally light guiding elements 346 to collect light from the sensor element 320 (see column 5, lines 12-16). Because the light has been collected from a specific target area, i.e. the sensor element 320, any detection volume of the detection assembly 340 would be divergent in a direction towards the collection optics 344, as is suggested by the illustration in figure 1b. Moreover, the excitation light source and detection volume do not overlap with one another since they each focus on to the sensor cell 320 from opposite sides.

With regard to Carlson, Applicants respectfully disagree with the Examiner that Carlson teaches a system in which excitation light forms a substantially collimated elongate beam that

projects, during use, from the fluorometer. Instead, the citation light produced by Carlson is directed on to a sample cell 21 via an optic fibre cable 17 and a lens 39 (see figure 1). However, the sample cell 21 forms part of the system 11 itself, and so no excitation beam is ever projected from the fluorometer. Please see in particular column 5, lines 50-51 where Carlson states "a sample cell was connected between those two fibres 17 and 19", and column 5, lines 63-66 where Carlson states that "the lens assembly comprising lenses 39 and 41 has been replaced by two planar converse quartz lenses attached directly to the sapphire windows of the cell 21". Accordingly, in Carlson's excitation system, the excitation light remains internal to the system 11 and is never projected from the system as a beam.

It is also noted that Carlson's excitation light and detection volume do not overlap. Nor could Carlson's detection volume be said to converge in a direction towards the fluorometer, since the detection volume is defined entirely within the system 11.

Therefore Carlson does not disclose the following features of Claim 1: *means for causing said excitation light to form, in use, a generally divergent conical beam projecting from the fluorometer, said beam comprising at least one collimating lens,* and *said at least one lens in the detection system is arranged to provide a generally conical convergent detection volume for the detection system, said generally conical detection volume converging in a direction towards said fluorometer and at least partially overlapping with said generally conical divergent beam.*

It is submitted that the combined teachings of Bentsen and Carlson could not lead a skilled person to the invention of Claim 1 since neither Bentsen nor Carlson discloses the above-identified features of Claim 1. Moreover, both Bentsen and Carlson are technically incompatible with the above-identified features of Claim 1 since both Bentsen and Carlson require that the excitation light is targeted on a specific target area, namely the sensor cell 320 or sample cell 21, and that correspondingly the detection volume is targeted on the same specific location. Therefore, using a generally conical divergent beam, as claimed in Claim 1, would be an inappropriate and highly inefficient way of targeting a sensor cell 320 or sample cell 21 and so would not be contemplated by the skilled person. Moreover, a skilled person would not select to use a beam that projects from the fluorometer since the sensor cell 320 and sample cell 21 are

located within the respective systems. For similar reasons, the skilled person would not chose to configure the detection systems of Bentsen or Carlson to provide a generally conical convergent detection volume for the detection system that converges in the direction towards the fluorometer since this is not required if the excitation beam not project from the fluorometer. Further, both Bentsen and Carlson teach that the excitation light and the detection system are positioned on opposite sides of the respective target cell 320, 21 and so the excitation beam and detection volume cannot overlap as recited in Claim 1.

It is also noted that neither Bentsen nor Carlson discloses a fluorometer that is capable of detecting fluorescent material located remotely from the fluorometer, as per Claim 1.

It is respectfully submitted therefore that amended Claim 1 is novel and non-obvious over the teachings of Bentsen and Carlson. The remaining claims being dependent directly or indirectly on Claim 1 are also submitted as being novel and non-obvious over the teachings of Bentsen and Carlson.

Therefore, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claims 1, 20 and 23 under 35 U.S.C. §103(a) over Tokhtuev et al. (WO 03/023379) in view of Carlson. This rejection is respectfully traversed.

Applicants further submit that Tokhtuev does not disclose at least the following features of amended Claim 1: *means for causing said excitation light to form, in use, a generally conical divergent beam projecting from the fluorometer, said beam causing means comprising at least one collimating lens,* and *said at least one lens in the detection system is arranged to provide a generally conical convergent detection volume for the detection system, said generally conical detection volume converging in a direction towards said fluorometer and at least partially overlapping with said generally conical divergent beam.*

For the reasons stated above in relation to Claim 1, Applicants also submit that Carlson does not disclose these features either. Hence, the combined teachings of Tokhtuev and Carlson could not lead a skilled person to the invention of Claim 1, since neither of these citations

discloses either of the two features of Claim 1 identified above.

Moreover, the object of Tokhtuev is to allow the detector to differentiate between different fluorescent substances in the same sample, and to correct for interfering compounds that cause optical back scatter (see paragraph [6]). To do this, Tokhtuev must have multiple channels focussed on to the same sample otherwise the different types of fluorescence and/or the back scatter cannot be measured from the same sample (see paragraphs [15] and [18] and in particular Claim 1 of Tokhtuev from which it can be seen that the mutual focussing system is presented as an essential element of Tokhtuev's invention). Therefore, the Tokhtuev invention will not work unless the excitation and detection channels are focussed on to a sample. It is submitted therefore that a skilled person would not modify Tokhtuev to replace the focussing system with the beam forming means of Claim 1, since this would remove an essential element of Tokhtuev's invention. Moreover, a skilled person faced with the problem of increasing the range of Tokhtuev, would take the simple step of adjusting the focussing system so that the point of focus is further from the sensor. Further, there is no requirement for Tokhtuev's apparatus to operate on anything other than a sample that is adjacent its sensor, and so Tokhtuev provides the skilled person with no incentive to increase its operating range.

For all of the reasons submitted above, it is respectfully submitted that Claim 1 is both novel and non-obvious over Tokhtuev and Carlson. The remaining claims, being dependent directly or indirectly on Claim 1, are also submitted as being novel and non-obvious.

With regard to Claim 20 in particular, Applicants respectfully disagree with the examiner that Tokhtuev shows the excitation system and the detection system being provided in respective housings. Figure 3 of Tokhtuev does show the excitation and the detection systems separately. However, the two drawings are two separate cross sections (an AA section and a BB section) of the same housing, i.e. the housing shown in figure 2. This can be seen from paragraph [15] of Tokhtuev. Therefore, Tokhtuev does not disclose that the excitation system and detection systems are in respective of housings, as per Claim 20. Moreover, with regard to the amendments made to Claim 20, Tokhtuev does not disclose that there is a generally conical divergent beam emanating from the excitation system housing, or that there is a generally

convergent detection volume created by the detection system housing. Since Tokhtuev and does not disclose these features, it is submitted that the combined teachings of Tokhtuev and Carlson could not lead a skilled person to the subject matter of Claim 20. In addition, as stated above in relation to Claim 1, both Tokhtuev and Carlson are technically incompatible with the provision of a generally conical divergent beam emanating from the excitation system and consequently with the generally conical convergent detection volume.

Therefore the combination of Tokhtuev and Carlson do not disclose or suggest all the features recited in Applicants' claims 1, 20 and 23. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claims 1, 20 and 23 under 35 U.S.C. §103(a) over Tokhtuev, Carlson and Frungel et al. (U.S. 3,666,945). This rejection is respectfully traversed.

Frungel was discussed in the Overview of the Remarks and is brought in by the Office Action for its housing teachings. However, notwithstanding this assertion, there is no discussion or suggestion in Frungel regarding the subject matter lacking in Tokhtuev and Carlson, as discussed above. Therefore, even if combined, Tokhtuev, Carlson and Frungel, do not disclose or suggest all the features recited in Applicants' claims 1, 20, and 23.

Accordingly, for at least the above discussed reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claims 24, 26, and 34 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, and in view of Michael (U.S. Patent No. 4,005,605). This rejection is respectfully traversed.

Michael is brought in by the Office Action asserting its teachings of an infrared thermometer. Notwithstanding this assertion, there is no teaching or suggestion in Michael regarding the various aspects found lacking in Tokhtuev and Carlson, as discussed above. Accordingly, even if combined, Tokhtuev, Carlson and Michael, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claims 24, 26 and 34 depend from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claim 25 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, Michael, and in view of Lazzara (U.S. Patent No. 3,996,476). This rejection is respectfully traversed.

Lazzara is brought in by the Office Action asserting its teachings of a photoelectric detector and has no discussion regarding fluorometers. Therefore, there is no teaching or suggestion in Michael regarding the various aspects found lacking in Tokhtuev and Carlson, as discussed above. Accordingly, even if combined, Tokhtuev, Carlson and Lazzara, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claim 25 depends from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claims 27-30 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, and in view of Bernstein et al. (U.S. Patent No. 4,496,839). This rejection is respectfully traversed.

Bernstein is brought in by the Office Action asserting its teachings of spectroscopy device and attendant housing for the spectroscopy hardware. Notwithstanding this assertion, there is no teaching or suggestion in Bernstein regarding the various aspects found lacking in Tokhtuev and Carlson, as discussed above. Specifically, there is no teaching or suggestion regarding at least the feature of *said generally conical detection volume converging in a direction towards the fluorometer and at least partially overlapping with said generally conical divergent beam,* as recited in Applicants' independent claim 1. Accordingly, even if combined, Tokhtuev, Carlson and Bernstein, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claims 27-30 depends from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claims 31 and 35 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, and in view of Chudnovsky (U.S. Patent No. 6,157,033). This rejection is respectfully traversed.

Chudnovsky is brought in by the Office Action asserting its teachings of leak detection system capable of being positioned. Notwithstanding this assertion, Chudnovsky is completely silent regarding the various aspects found lacking in Tokhtuev and Carlson, as discussed above. Accordingly, even if combined, Tokhtuev, Carlson and Chudnovsky, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claims 31 and 35 depend from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claim 32 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, and in view of Field (U.S. Patent Publication No. 2005/0174793). This rejection is respectfully traversed.

Field is brought in by the Office Action asserting its teachings of a slidable light source. Notwithstanding this assertion, Field, as being directed to a headlight, is completely silent regarding the various aspects found lacking in Tokhtuev and Carlson, as discussed above. Accordingly, even if combined, Tokhtuev, Carlson and Field, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claim 32 depends from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claim 33 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, and in view of Zielke et al. (U.S. Patent No. 3,554,653). This rejection is respectfully traversed.

Zielke is brought in by the Office Action asserting its teachings of an autocollimator. Notwithstanding this assertion, Zielke, being directed to a simple collimating device, is completely silent about the various aspects found lacking in Tokhtuev and Carlson, as discussed

above. Accordingly, even if combined, Tokhtuev, Carlson and Zielke, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claim 33 depends from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

The Office Action rejects Claims 36 and 37 under 35 U.S.C. §103(a) over Tokhtuev, Carlson, and in view of Geiger (U.S. Patent No. 5,947,051). This rejection is respectfully traversed.

Geiger is brought in by the Office Action asserting its teachings of an underwater vehicle, carrying a fluorometer. Notwithstanding this assertion, there is no teaching or suggestion in Geiger regarding the various aspects found lacking in Tokhtuev and Carlson, as discussed above. Accordingly, even if combined, Tokhtuev, Carlson and Geiger, do not disclose or suggest all the features recited by Applicants' independent claim 1.

Claims 36-37 depend from claim 1. Accordingly, for at least the above reasons, the withdrawal of this rejection is respectfully requested.

Regarding Applicants' added claims 41, which is dependent on Claim 20, none of the citations disclose a fluorometer in which the excitation and detection systems are provided in separate housings and wherein the respective housings have a respective longitudinal axis, said longitudinal axis being substantially parallel with one another, and said generally conical divergent beam and said generally conical convergent detection volume are substantially aligned with said respective longitudinal axis. This arrangement can be seen for example in figures 1 and 2 of the present application.

In contrast to the features of Claim 41, Bentsen and Carlson provide the excitation and detection systems in housings that oppose each other on either side of the sample cell 21/sensor element 230, Tokhtuev houses both its excitation and detection system in a common housing so that both the excitation beam and detection volume are focussed on a common target (see Figure 1), and Frungel must have its detection and excitation system obliquely disposed with respect to

one another so that they can focus on a specific target area (see Figure 1). Moreover, it is submitted that none of these prior art devices could be modified in the manner of Claim 41 because of technical incompatibility: in Bentsen and Carlson, the excitation and detection systems need to be aligned on either side of a sample cell/sensor element, while in Tokhtuev and Frungel the excitation and detection systems must be focussed on to a specific target area, and this is not compatible with having separate substantially parallel housings.

With regard to new claims 39 and 40, none of the citations are capable of causing fluorescence in fluorescent material at a distances of up to several metres from a fluorometer, and in particular at distances of between 1 and 15 metres from the fluorometer. In contrast, Bentsen and Carlson create fluorescence within the fluorometer itself, whereas Tokhtuev and Frungel focus on a target area that is only a few inches in front of the fluorometer.

Turning now to new Claim 42, this claim recites a fluorometer incorporating the features of claims 1, 20, 39 and 41. For the reasons given above in relation to Claims 1, 20, 39 and 41, and it is respectfully submitted that the fluorometer of Claim 42 is both novel and non-obvious over the cited prior art.

New Claim 43 is dependent on Claim 43 and as such is also submitted as being novel and non-obvious over the cited prior art.

CONCLUSION

In light of the foregoing, Applicants submit that the application is in condition for allowance. If the Examiner believes the application is not in condition for allowance, Applicants respectfully request that the Examiner call the undersigned.

Respectfully submitted,
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